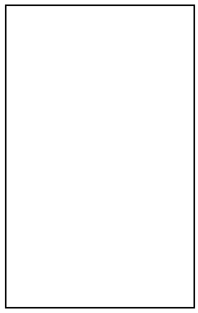
Wu= 1.4DL+1.7L.L

DL..

Concrete slabs= 24*60=3.84 KN/m^2

Concrete tiles=20*0.04=0.8kn/m^2



Soil=18*0.15=2.7kn/m^2

Sand=16.5*0.03=0.5kn/m^2

DL=7.84kn/m^2

LL==2kn/m^2

Wu=1.4*7.84+1.7*2

=10.976+3.4=14.38kn/m^2

Thick of slab=160mm

Design slab(1)

$\frac{Lb}{La}$ =7/6=1.167<2

m^-	M^+dL	M^+LL	W
Ca=0.072 Cb=0.013	Ca=0.028 Cb=0.013	Ca=0.032 Cb=0.02	Wa=0.72 Wb=0.21

Design as two way slab

Short direction

Ma^-=ca*wu*La^2

=0.072*14.38*$(6)^2$

=37kn.m

Ma^+=(ca ,DL*wu ,DL+ca .LL*wu ,LL)*$(La)^2$

=(0.028*10.976+0.032*3.4)*$(6)^2$

=15kn.m

Moment in column strip=2/3*M middle

M^-=0.67*37=25KN.M

M^+=.67*15=10KN.M

Long direction

Mb^-=0.021*14.38*$(7)^2$=14.8kn.m

Mb^+=(0.013*10.796+0.02*3.4)*$(7)^2$=10.32kn.m

M^- at discontinuous end=1/3*M^+

=.33*10.32=3.44Kn.m

Moment in column strip=2/3*M middle

=0.67*14.8=9.86kn.m

-9.86	-14.8	-9.86
+6.88	+10.32	+6.88
-2.3	-3.44	-2.3

Long direction

-25	+10	-25
-37	+15	-37
-25	+10	-25

short direction

Short direction
da=160-20-12/2=134mm

Max moment=37kn.m

P=5.78*10^{-3} fc'=25mpa

b=1000mm d=134mm

$$\rho min = \frac{1.4}{420} = .033$$

$$\rho max = .75 * \rho b = 0.02$$

$$\rho min < \rho < \rho max$$

As=5.78*10^{-3}*1000*134

As=774.52mm^2

$$S = MIN(\frac{113}{774.52} * 1000, 2 * 160, 500)$$

=MIN(150,320,500)

S=150mm

$$no\ of\ bars = \frac{AS}{AB} = \frac{750.4}{113} = 7bar@each(1m)$$

Short direction
max moment=14.8KN.M

$\rho = 0.003$

$\rho min < \rho < \rho max$

AS=3.3*10^{-3}*1000*122=403MM^2

Middle strip space

$$S = MIN\left(\frac{113}{403} * 1000, 2 * 160, 500\right)$$

S=MIN(280,320,500)

S=280MM

No of bars=403/113=4bars @each(1m)

When fc^{-}=50mpa

$\rho = 0.00267$

$\rho = \rho MIN = 0.033$

AS=3.3*10^{-3}*1000*122

=403mm^2

S=min(113/403*1000,2*160,500)

=min(280,320,500)

S=280mm

No of bars=403/113=4 bars@ each(1m)

CHECK SHEAR

W=wu*La*Lb

=14.38*6*7

W=604

Wa=W* wa

=604*0.79=477

Wb=W*w b

Wb=604*0.21

Wb=127

Va=Wa/2Lb=477/14

Va=34kn

Vb=Wb/2La=127/12=11kn

$Va > Vb$

اكتب المعادلة هنا. $\frac{(Va - wu * wa * da)}{\emptyset} = \frac{34 - 14.38 * 0.79 * 0.134}{0.85} = 38.2kn$

$Vc = 0.17 * \sqrt{fc} * b * dave$

Fc`=25mpa

Vc=108.8kn more than 38.2kn .....ok

Fc`=50mpa

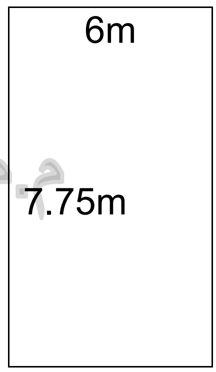
VC=154kn more than 38.2kn .....ok

DESIGN SLAB(2)

Lb/La=7.25/6=1.3

Design two way slab

M=La/Lb=6/7.25=0.75



Short direction

Ma^{-}=ca*wu*la^2

=0.078*14.38*$(6)^2$=40.38kn.m

Ma^{+}=[ca ,DL*wu ,DL+ca ,LL*wu ,LL]*$(la)^2$

=0.031*10.796+0.046*3.4]*$(6)^2$=17.88kn.m

Moment in column strip=2/3*M middle

M^{-}=2/3*40.38=26.92kn.m

M^{+}=2/3*17.88=11.92kn.m

M^{-}	M^{+}DL	M^{+}LL	W load
Ca=0.073 Cb=0.014	Ca=0.031 Cb=0.007	Ca=0.046 Cb=0.013	Wa=0.86 Wb=0.14

Long direction

Mb^{-}=cb*wu*Lb^{2}

=0.014*14.38*$(7.75)^{2}$=12kn.m

Mb^{+}=[0.007*10.976+0.013*3.4]*$(7.75)^{2}$=7.27kn.m

M^{-} at discontinuous end=1/3*M^{+}

=1/3*2.27[2.42kn.m

M in column strip=2/3*M middle

=0.67*2.42=1.61kn.m

M^{-}=0.67*12=8kn.m

M^{+}=0.67*7.27=4.85kn.m

-1.16	-2.42	-1.16
+4.85	+7.27	+4.85
-8	-12	-8

Long direction

short direction

da=160-20-12/2=134mm

max moment=40.38kn.

-26.92	+11.92	-26.92
-40.38	+17.88	-40.38
-26.92	+11.92	-26.92

$\rho = 0.00635$

$\rho min = .0033$

$.\rho max = 0.02$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.00635*1000*134

As=851mm^{2}

S=min[113/851*1000,2*160,500]

S=130mm

No of bars=851/113=8 bars@ each(1m)

Fc`=50mpa

Max moment=40.38kn.m

$\rho = 0.00613$

$\rho min = 0.0033$

$\rho max = 0.04$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.00613*1000*134

As=821.42mm^2

S=min[113*821.42*1000,2*160,500]

S=130mm

No of bars=821.42/113=8 bars@ each(1m)

Long direction

db=122mm

max moment=12kn.m

$fc` = 25mpa$

$\rho = 0.00218$

$\rho min > \rho$

$\rho min = \rho$

$AS = \rho * b * d$

As=0.0033*1000*122

As=403mm^2

S=[113/403*1000,2*160,500]

S=280mm

No of bars=403/113=4 bars@ each (1m)

Fc`=50mpa

$\rho = 0.0022$

$\rho min = \rho$

$As = \rho * b * d$

As=.0033*1000*122

As=403mm^2

S=[113/403*1000,2*160,500]

S=280mm

No of bars=403/113=4 bars @ each(1m)

CHECK SHEAR

W=wu*La*Lb

W=14.38*6*7.75

W=668

Wa=W*wa=668*0.86=574

Wb=W*wb=668*0.14=94

Va=Wa/2Lb=574/2*7.75=37

Vb=Wb/2La=94/12=7.83

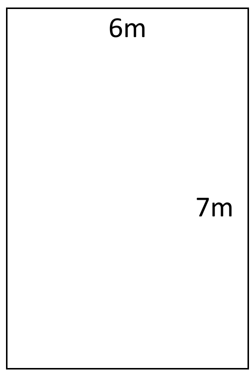
$$VA > VB$$

$$\frac{Va - wu * wa * da}{\emptyset} = \frac{37 - 14.38 * 0.86 * 0.134}{0.85} = 42kn$$

$$Vc = 0.17 * \sqrt{fc`} * b * d = 108.8kn > 42 \ldots\ldots\ldots\ldots ok$$

$$fc` = 50mpa$$

$$vc = 154kn > 42kn \qquad \ldots\ldots\ldots\ldots\ldots\ldots ok$$



DESIGN SLAB(3)

Lb/La=7/6=1.167

Design two way slab

M=La/Lb=6/7=0.85

M^-	M^+DL	M^+LL	W Load
Ca=0.065 Cb=0.034	Ca=0.036 Cb=0.019	Ca=0.043 Cb=0.023	Wa=0.66 Wb=0.34

Short direction

Ma^{-}=ca*wu*La^2=0.065*14.38*$(6)^2$=33.65kn.m

Ma^{+}=[0.036*10.976+0.043*3.4]*(6^2)=19.48kn.m

M^{-} at discontinuous end=1/3*M^{+}

=1/3*19.48=6.5kn.m

Moment in column strip=2/3*M middle

M^{-}=2/3*6.5=4.33kn.m

M^{-}=2/3*33.65=22.43kn.m

M^{+}=2/3*19.48kn.m

Long direction

Mb^{-}=0.034*14.38*$(7)^2$=24kn.m

Mb^{+}=[0.019*10.976+0.023*3.4]*$(7)^2$=14kn.m

M^{-} at discontinuous end=1/3*M^{+}

=1/3*14=4.67kn.m

-16	-24	-16
+9.33	+14	+9.33
-3	-4.67	-3

Moment in column strip=2/3*M middle

M^{-}=2/3*4.67=3kn.m

M^{-}=2/3*24=16kn.m

M^{+}=2/3*14=9.33kn.m

-22043	+9.65	-4.33
-33.65	+19.48	-6.5
-22.43	+9.65	-4.33

short direction

da=134mm

max moment=33.65kn.m

$fc` = 25mpa$

.$\rho = 0.00523$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.00523*1000*134=700

S=min[113/700* 1000,2*160,500]

S=160mm

No of bars=700/113=7 bars@ each (1m)

$fc` = 50mpa$

$mu = 33.65kn.m$

$\rho = 0.0051$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.0051*1000*134

As=683.4mm^2

S=[1000*113/683.4,2*160,500]

S=160mm

No of bars=683.4/113=7 bars @ each(1m)

Long direction

db=122mm

max moment=24kn.m

$\rho = 0.0045$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.0045*1000*122

As=549mm^2

S=[113/549*1000,2*160,500]

S=200mm

No of bars=549/113=5 bars @ each(1m)

$fc` = 50mpa$

$mu = 24kn.m$

$\rho = 0.00436$

$\rho min < \rho < \rho max$

$As = \rho * b * d$

As=0.00436*1000*122

As=532mm^2

S=[113/532*1000,2*160*500]

S=210mm

No of bars=532/113=5 bars @ each (1m)

CHECK SHEAR

W=wu*La*Lb

W=14.38*6*7=604

Wa=W*wa

Wa=604*0.66=398.84

Wb=W*wb

Wb=604*0.34=205.36

Va=398.84/2*7=28

Vb=205.36/2*6=17

$Va > Vb$

$$\frac{Va - wu * wa * d}{\emptyset} = \frac{28 - 14.38 * 0.66 * 0.134}{0.85} = 31kn$$

$Vc = 0.17\sqrt{25} * 1000 * 128 = 108.8 > 31kn$

$fc` = 50mpa$

$Vc = 154kn > 31kn \qquad \ldots\ldots.ok$

DESIGN SLAB(4)

Lb/La=5.15/4=1.28

Design two way slab

M=La/Lb=4/5.15=0.75



Short direction

$Ma^{-}=0.088*14.38*(4)^{2}$

$Ma^{-}=20.24kn.m$

$Ma^{+}=[0.048*10.976+0.055*3.4]*(4)^{2}$

$Ma^{+}=11.42kn.m$

Long direction

$Mb^{-}=0.024*14.38*(5.15)^{2}$

$Mb^{-}=9.15kn.m$

$Mb^{+}=[0.012*10.976+0.016*3.4]*(5.15)^{2}$

$Mb^{+}=5KN.M$

Short direction
da=134mm

Max moment=20.24kn.m

$FC` = 25MPa$

ρ =0.0031

$\rho = \rho min$

$\rho = .0033$

$AS = \rho * b * d$

M^{-}	M^{+} DL	M^{+}LL	W load
Ca=0.088 Cb=0.024	Ca=0.048 Cb=0.012	Ca=0.055 Cb=0.016	Wa=0.88 Wb=0.12

AS=.0033*1000*134

$AS=442.2mm^{2}$

S=[113/442.2*1000,2*160,500]

S=250mm

No of bars=442.2/113=4 bars@ each(1m)

$FC` = 50mpa$

$\rho = 0.0031$

$\rho min > \rho$

$AS = \rho * b * d$

AS=0.0033*1000*134

AS=442.2mm^2

S=[113/442.2*1000,2*160,500]

S=250mm

No of bars=442.2/113=4 bars@ each(1m)

Long direction

db=122mm

max moment=5kn.m

$FC` = 25mpa$

$\rho = 0.00896$

$\rho min > \rho$

$AS = \rho * b * d$

AS=.0033*1000*122

AS=403mm^2

S=[113/403*1000,2/160,500]

S=280mm

No of bars=403/113=4bars@each(1m)

CHECK SHEAR

W=wu*La*Lb

W=14.38*4*5.15

W=296

Wa=W*wa=296*0.88=260

Wb=W*wb=296*0.12=36

Va=Wa/2lb=260/2*5.15=25kn

Vb=Wb/2La=36/2*4=4.5kn

$Va > Vb$

$$\frac{Va - wu * wa * d}{\emptyset} = \frac{25 - 14.38 * 0.88 * 0.134}{0.85} = 27.42kn$$

$Vc = 0.17 * \sqrt{fc`} * b * d$

$fc` = 25mpa$

$Vc = 108.8kn > 27.42kn \quad \ldots\ldots\ldots ok$

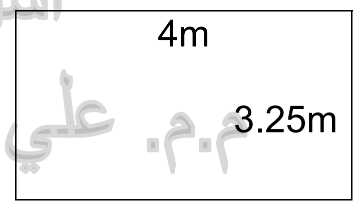
$fc` = 50mpa$

$Vc = 154kn > 27.42kn \quad \ldots\ldots\ldots\ldots ok$

DESIGN SLAB(5)

Lb/La=4/3.25=1.2

Design two way slab



M=3.25/4=0.8

Short direction

$Ma^{-}=0.065*14.38*(3.25)^2$

$Ma^{-}=9.87kn.m$

$Ma^{+}=[0.026*10.976+0.041*3.4]*(3.25)^2$

$Ma^{+}=4.5kn.m$

M^-	M^+ DL	M^+ LL	W load
Ca=0.026 Cb=0.011	Ca=0.026 Cb=0.014	Ca=0.041 Cb=0.017	Wa=0.71 Wb=0.29

Long direction

$Mb^{-}=0.026*14.38*(4)^2$

$Mb^{+}=[0.011*10.976+0.017*3.4]*(4)^2$

$Mb^{+}=2.9kn.m$

-6.58	-9.87	-6.58
+0.75	+4.5	+0.75
-6.58	-9.87	-6.58

Short direction

SHORT DIRECTION

da=134mm

max moment=9.87kn.m

$fc` = 25mpa$

$\rho = 0.00147$

$\rho min > \rho$

$AS = \rho min * b * d$

AS=0.0033*1000*134

$AS=442.2mm^2$

-4.13	+1.93	-4.13
-6.2	+2.9	-6.2
-4.13	+1.93	-4.13

Long direction

S=[113/442.2*1000,2*160,500]

S=250mm

No of bars=442.2/113=4bars@ each(1m)

$fc` = 50mpa$

$mu = 9.87kn.m$

$\rho = 0.00146$

$\rho min > \rho$

$AS = \rho * b * d$

AS=0.0033*1000*134

$AS=442.2mm^2$

S=min[113/442.2*1000,2*160,500]

S=250mm

No of bars=442.2/113=4 bars@ each(1m)

LONG DIRECTION

db=122mm

max moment=6.2kn.m

$fc` = 25mpa$

$\rho = 0.0011$

$\rho min > \rho$

$AS = \rho * b * d$

AS=0.0033*1000*122

AS=403mm^2

S=min[1000*113/403,2*160,500]

S=280mm

No of bars=403/113=4 bars @ each(1m)

$fc` = 50mpa$

$mu = 6.2kn.m$

$\rho = 0.0011$

$\rho min > \rho$

$As = \rho * b * d$

AS=0.0033*1000*122

AS=403mm^2

S=min[1000*113/403,2*160,500]

S=280mm

No of bars=403/113=4 bars @ each(1m)

CHECK SHEAR

W=wu*La*Lb

W=14.38*3.25*4

W=187

Wa=W*wa

Wa=187*0.71=133

Wb=W*wb

Wb=187*0.29=54

Va=Wa/2Lb

Va=133/2*4=17

Vb=Wb/2La

Vb=54/2*3.25=8.3

$Va > Vb$

$$\frac{Va - wu * wa * d}{\emptyset} = \frac{17 - 14.38 * 0.71 * 0.134}{0.85}$$
$$= 18.4kn$$

اكتب المعادلة هنا. $c = 0.17 * \sqrt{fc`} * b * d$

$fc` = 25mpa$

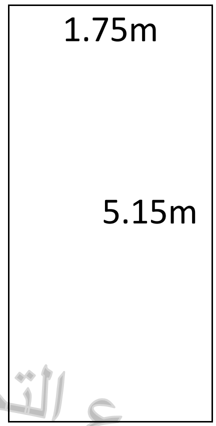
$Vc = 108.8kn > 18.4kn \quad \dots\dots.ok$

$fc` = 50mpa$

$Vc = 154kn > 18.4kn \quad \dots\dots\dots ok$

DESIGN SLAB(6)

Lb/La=5.15/1.75=2.9>2



Design one way slab

d=t-cover-12/2

d=160-20-6=134mm

thickness of slab=160mm

$$mu = wu * \frac{ln2}{10} = 14.38 * \frac{(1.75)2}{10} = 4.4kn.m$$

$$mu = wu * \frac{ln2}{11} = 14.38 * \frac{(1.75)2}{11} = 4kn.m$$

$$mu = wu * \frac{ln2}{16} = 14.38 * \frac{(1.75)2}{16} = 2.75kn$$

max $momen = 4.4kn.m$

$fc` = 25mpa$

$\rho = .00065$

$\rho min > \rho$

$AS = \rho min * b * d$
As=0.0033*1000*134

AS=442.2mm^2

اكتب المعادلة هنا.

S=min[1000*113/442.2,2*160,500]

S=250mm

Spacing for shrinkage and temperature

S=min[1000*113/288,5*160,500]

S=460mm

No of bars =442.2/113=4 bars @ each(1m)

$fc` = 50mpa$

$\rho = 0.00065$

$\rho min > \rho$

$AS = \rho * b * d$

$As=0.0033*1000*134$

$AS=442.2mm^2$

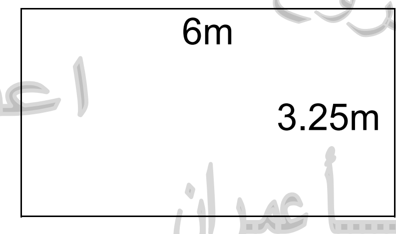
S main=250mm

S shrinkage=460mm

No of bars=4 bars @ each (1m)

DESIGN SLAB (7)

$Lb/La=6/3.25=1.8$



Design two way slab

$M=3.25/6=0.55$

Short direction

$Ma^-=0.084*14.38*(3.25)^2$

$Ma^-=12.75kn.m$

$Ma^+=[0.035*10.976+0.062*3.4]*(3.25)^2$

$Ma^+=6.3kn.m$

Long direction

$Mb^-=0.007*14.38*(6)^2$

$Mb^-=3.6kn.m$

$Mb^+=[0.003*10.976+0.006*3.4]*(6)^2$

$Mb^+=1.92kn.m$

M^-	M^+ DL	M^+ LL	W load
Ca=0.084 Cb=0.007	Ca=0.035 Cb=0.003	Ca=0.062 Cb=0.006	Wa=0.92 Wb=0.08

-2.4	+1.28	-2.4
-3.6	+1.92	-3.6
-2.4	+1.28	-2.4

Long direction

-8.5	-12.76	-8.5
+4.2	+6.3	+4.2
-8.5	-12.76	-8.5

Short direction

SHORT DIRECTION

da=134mm

max moment=12.76kn.m

$fc` = 25mpa$

$\rho = 0.00192$

$\rho min > \rho$

$AS = \rho * b * d$

As=0.003*1000*134

As=442.2mm^2

S=min[1000*113/442.2,2*160,500]

S=250mm

No of bars=442.2/113=4 bars @ each (1m)

$fc` = 50mpa$

$mu = 12.76kn.m$

$\rho = 0.00189$

$\rho min > \rho$

$AS = \rho * b * d$

As=0.0033*1000*134

As=442.2mm^2

S=min[1000*113/442.2,2*160,500]

S=250mm

No of bars=442.2/113=4 bars @ each(1m)

LONG DIRECTION

db=122mm

max moment=3.6kn.m

$fc` = 25mpa$

$\rho = 0.000644$

$\rho min > \rho$

$AS = \rho * b * d$

AS=0.003*1000*122

AS=403mm^2

S=min[1000*113/403,2*160,500]

S=280mm

No of bars=403/113=4 bars @ each (1m)

$fc` = 50mpa$

$mu = 3.6kn.m$

$\rho = 0.00064$

$\rho min > \rho$

$AS = \rho min * b * d$

AS=0.003*1000*122

AS=403mm^2

S=min[1000*113/403,2*160,500]

S=280mm

No of bars=403/113=4 bars @ each (1m)

CHECK SHEAR

W=wu*La*Lb

W=14.38*6*3.25

W=280mm

Wa=W*wa

Wa=280*0.91=255

Wb=W*wb

Wb=280*0.08=22

Va=Wa/2Lb=255/2*6=21.3

Vb=Wb/2La=22/2*3.25=3.4

$Va > Vb$

$$\frac{\mathrm{Va} - \mathrm{wu} * \mathrm{wa} * \mathrm{d}}{\emptyset} = \frac{21.3 - 14.38 * 0.92 * 0.134}{0.085} = 23\mathrm{kn}$$

$Vc = 0.17 * \sqrt{fc`} * b * d$

$fc` = 25mpa$

$Vc = 108.8kn > 23kn \quad \ldots\ldots\ldots,ok$

$fc` = 50mpa$

$Vc = 154kn > 23kn \quad \ldots\ldots\ldots.ok$

Slab no	direct	Mu Kn.m	ρ	ρ	AS	AS	S	S
			Fc`=25	Fc`=50	Fc`=25	Fc`=50	Fc`=25	Fc`=50
S1	Short Long	38.88 15.4	0.0061 0.0033	0.006 0.003	817 403	804 403	130 280	140 280
S2	Short Long	42.12 8.76	0.0066 0.0016	0.0064 0.0016	884.4 403	858 403	120 280	130 280
S3	Short Long	10.29 6.48	0.0015 0.0012	0.0015 0.0012	442.2 403	442.2 403	250 280	250 280
S4	Short Long	35.64 16.66	0.0056 0.0031	0.0054 0.0033	750.4 403	724 403	150 280	150 280
S5	Short Long	21.12 5.5	0.0032 0.0098	0.0032 0.0098	442.2 403	442.2 403	250 280	250 280
S6	Short Long	4.6	0.0068	0.007	442.2	442.2	250	250
S7	Short Long	13.3 3.78	0.002 0.0064	0.00197 0.00674	442.2 403	442.2 403	250 280	250 280

For ground plan

Slab no	direct	Mu Kn.m	ρ	ρ	AS Mm^2	AS Mm^2	S mm	S mm
			Fc`=25	Fc`=25	Fc`=25	Fc`=50	Fc`=25	Fc`=50
S1	Short Long	37 14.8	0.0057 0.0033	0.0056 0.0026	774.5 403	750.4 403	140 250	150 280
S2	Short Long	46.38 12	0.0063 0.0021	0.0061 0.0022	851 403	821.42 403	130 260	130 280
S3	Short Long	9.87 6.2	0.0015	0.0015	442.2	442.2	250	250
S4	Short Long	33.65 24	0.0052 0.0045	0.0051 0.0045	683.4 532	683.4 532	160 200	160 280
S5	Short Long	20.24 5	0.0031 0.0089	0.0031 0.0011	442.2 403	442.2 403	250 280	250 280
S6	Short Long	4.4	0.0065	0.0065	442.2	442.2	250	250
S7	Short Long	12.76 3.6	0.0019 0.0064	0.0019 0.0064	442.2 403	442.2 403	250 280	250 280

For first plane

DESIGN OF COLUMN

Wu=14.38kn.m

Weight of stem=(0.35-0.16)*0.25*25*1.4=1.67kn/m

Partition=1.5*0.25*20*1.4=10.5kn/m

Dimension of column=400mm*400mm

Weight of column=0.4*0.4*3.5*25*1.4=19.6kn/m

d`=40+10+25/2=62.5mm

DESIGN COL(1)

Fc`=25mpa

Pu=14.38(2.27*2.85)+(1.67*2.85)+(1.67*2.27)+19.6+10.5

Pu=131.6kn

Moment from both side…………biaxial

$$wu(x) = \frac{14.38 * 4.25}{3} + 1.67 + 10.5$$

Wu(x)=32.54kn/m

$$wu(y) = \frac{14.38 * 4.25}{3} * \frac{(3 - 0.78)}{2} + 1.67 + 10.5$$

Wu(y)36.4kn/m

$$mu\ x = \frac{36.4(5.4 - 0.4)}{16} = 59.17 kn.m$$

$$mu\ y = \frac{32.54(4.25 - 0.4)}{13} = 31.73 kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{31.73}{59.14} = 0.54 < \frac{b}{h} = 1$$

Mu eq=59.17+31.73(0.4/0.4)*(1-0.65)/0.65

Mu eq=76.25kn.m

$$\gamma = \frac{400 - 2 * 62.5}{400} == 0.7$$

$$kn = \frac{131.6}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.05$$

$$Rn = \frac{76.25}{0.7 * 25 * 0.4 * 0.4 * 0.4 * 1000} = 0.068$$

From chart………………….$\rho g = \rho min = 0.01$

$AS = \rho g * b * h$

$AS = 0.01 * 400 * 400$

AS=1600mm^2

Ab=490mm^2

$$no\ of\ bars = \frac{1600}{490} = 3.2$$

$use\ 4\ \theta\ 25$

Fc`=50mpa

Dimension of column=300mm*300mm

Weight of column=11.025kn/m

Weight of stem=1.67kn/m

Partition=10.5kn/m

Pu=123.11kn

Mu=76.25kn.m

$$Rn = \frac{76.25}{0.7 * 50 * 0.3 * 0.3 * 0.3 * 1000} = 0.08$$

$$kn = \frac{123.1}{0.7 * 50 * 0.3 * 0.3 * 1000} = 0.04$$

$\rho g = 0.011$

$As=0.011*300*300=990mm^2$

No of bars=990/490=2.02

$use\ 3\ \theta\ 25$

DESIGN COL(2)

Fc`=25mpa

Pu=14.38(3.125*2.85)+1.67*2.85+1.67*3.125+19.6+10.5

Pu=168.6kn

$$wu\ y = \frac{14.38*4.25}{3} + 1.67 + 10.5 = 32.54\frac{kn}{m}$$

$$wu\ x = \frac{14.38*5.4}{3}*\frac{3-0.78}{2} + 1.67 + \frac{14.38*2}{2} = 47\frac{kn}{m}$$

$$mu\ x = \frac{47(5.1)}{10} = 123.3kn.m$$

$$mu\ y = \frac{32.54(4.25-0.4)}{10} = 50.8kn.m$$

$$mu\ eq = 123.3 + 50.8\left(\frac{0.4}{0.4}\right)*\frac{1-0.65}{0.65} = 149.65kn.m$$

$$\gamma = 0.7$$

$$kn = \frac{168.6}{0.7*25*0.4*0.4*1000} = 0.06$$

$$Rn = \frac{149.65}{0.7*25*0.4*0.4*0.4*1000} = 0.134$$

$$\rho g = 0.018 \ldots\ldots\ldots\ldots \rho min < \rho < max$$

$As=0.018*400*400=2880mm^2$

No of bars=2880/490=5.8

$use\ 6\ \theta\ 25$

Fc`=50mpa

Pu=160.6kn

Mu=149.65kn.m

Kn=0.05

Rn=0.16

$\gamma = 0.6$

$\rho g = 0.028 \ldots \ldots .. \rho min < \rho < \rho max$

As=0.028*300*300=2520mm^2

No of bars=2520/490=5.14

$use\ 6\ \theta\ 25$

DESIGN COL(3)

Fc`=25mpa

Pu=14.38(4.125*3.78)+1.67*3.78+1.67*4.125+19.6

Pu=257kn

$$wu\ x = \frac{14.38 * 6.25}{3} * \frac{(3 - 0.86)}{2} + 1.67 = \frac{49.85kn}{m}$$

$$wu\ y = (14.38 * \frac{6.250}{3} + 1.67 = \frac{31.63kn}{m}$$

$$mu\ x = \frac{49.85(7.5 - 0.4)}{10} = 258.4kn.m$$

$$mu\ y = \frac{31.63(6.25 - 0.4)}{10} = 111.97kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{111.97}{258.4} = 0.45 < \frac{b}{h}$$

$$mu\ eq = 258.4 + \frac{111.97\left(\frac{0.4}{0.4}\right)(1 - 0.65)}{0.65} = 318.7kn.m$$

$$kn = \frac{257}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.1$$

$$Rn = \frac{318.7}{0.7 * 25 * 0.4 * 0.4 * 0.4 * 1000} = 0.28$$

$\rho g = 0.044 \ldots \ldots \rho min < \rho < \rho max$

AS=0.044*400*400=7040mm^2

No of bars=7040/490=13.36

$use\ 14\ \theta\ 25$

Fc`=50mpa

Pu=248.43kn

Mu eq=318.7kn.m

$\gamma = 0.6$

$$kn = \frac{248.43}{0.7 * 50 * .03 * .03 * 1000} = 0.08$$

$$Rn = \frac{318.7}{0.7 * 50 * 0.3 * 0.3 * 0.3 * 1000} = 0.33$$

From chart

$\rho g = 0.062 \ldots \ldots \rho min < \rho < \rho max$

AS=0.062*300*300=5580mm^2

No of bars=5580/490=11.38

$use\ 12\ \theta\ 25$

DESIGN COL (4)

Fc`=25mpa

Pu=14.38(3.8*3.3)+1.67*3.3+1.67*3.8+19.6

Pu=211.8kn

$$wu\ x = \frac{14.38 * 6.25}{3} * \frac{3 - 0.86}{2} + 1.67 = 33.8\ kn/m$$

$$wu\ y = \frac{14.38 * 6.25}{3} + 1.67 = 31.63 \frac{kn}{m}$$

$$mu\ x = \frac{33.8 * 6.85}{16} = 163.3 kn.m$$

$$31.63 * 5.85$$

$$\frac{mu\ y}{mu\ x} = \frac{111.9}{163.3} = 0.68 < \frac{b}{h}$$

$$mu\ eq = 163.3 + 111.9\left(\frac{0.4}{0.4}\right) * \frac{1-0.65}{0.65}$$

$$= 223.56kn.m$$

$$\gamma = 0.7$$

$$kn = \frac{211.8}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.08$$

$$Rn = \frac{223.56}{0.7 * 25 * 0.4 * 0.4 * 0.4 * 1000} = 0.2$$

$$\rho g = 0.032 \dots \dots \rho min < \rho < \rho max$$

AS=0.032*400*400=5120mm

$$no\ of\ bars = \frac{5120}{490} = 10.4$$

$$use\ 11\ \theta\ 25$$

Fc`=50mpa

Pu=203.2kn

Mu eq=223.56kn.m

$$\gamma = 0.6$$

$$kn = \frac{203.2}{0.7 * 50 * 0.3 * 0.3 * 1000} = 0.06$$

$$Rn = \frac{223.56}{0.7 * 50 * 0.3 * 0.3 * 0.3 * 1000} = 0.24$$

$$\rho g = 0.045 \dots \dots \rho min < \rho max$$

$$AS = 0.045 * 300 * 300 = 4050\ mm$$

$$no\ of\ bars = \frac{4050}{490} = 8.26$$

$use\ 9\ \theta\ 25$

DESIGN COL(5)

Fc`=25mpa

Pu=14.38(5.5*6.25)+1.67*5.5+1.67*6.25+19.6

Pu=533.5kn

$$wu\ x = 2\left[\frac{14.38 * 6.25}{3} * \frac{3-0.86}{2}\right] + 1.67 = \frac{69.27kn}{m}$$

$$wu\ x = 2\left[\frac{14.38 * 3.5}{3}\right] + 1.67 = \frac{35.22kn}{m}$$

$$mu\ x = \frac{69.27 * 6.85}{10} - \frac{35.22 * 3.1}{10} = 298.53kn.m$$

$$mu\ y = 0$$

$$\gamma = 0.7$$

$$kn = \frac{533.5}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.19$$

$$Rn = \frac{298.53}{0.7 * 25 * 0.4 * 0.4 * 0.4 * 1000} = 0.26$$

$$\rho g = 0.037 \ldots\ldots \rho min < \rho < \rho max$$

$$AS = 0.037 * 400 * 400 = 5920mm$$

$$no\ of\ bars = \frac{5920}{490} = 11.9 \qquad use 12\ \theta\ 25$$

Fc`=50mpa

Pu=525kn

Mu=298.53kn.m

$$kn = \frac{525}{0.7 * 50 * 0.3 * 0.3 * 1000} = 0.16$$

$$Rn = \frac{298.53}{0.7 * 50 * .3 * .3 * .3 * 1000} = 0.3$$

$\rho g = 0.054$

$AS = 0.054 * 300 * 300 = 4860mm$

$no\ of\ bars = \frac{4860}{490} = 9.9$

$use\ 10\ \theta\ 25$

DESIGN COL (6)

Pu=14.38(6.25*3.8)+1.67*6.25+1.67*3.8+19.6+10.5

Pu=107.78kn

$$wu\ x = 2\left[\frac{14.38 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 10.5 = \frac{79.78kn}{m}$$

$$wu\ y = \frac{14.38 * 6.25}{3} + 1.67 + 10.5 = \frac{42.13kn}{m}$$

$$mu\ x = \frac{79.78 * 6.85}{16} = 333.96kn.m$$

$$mu\ y = \frac{42.13 * 5.85}{10} = 144.2kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{144.2}{323.96} = 0.005 < \frac{b}{h}$$

$$mu\ eq = 323.96 + 144.2\left(\frac{0.4}{0.4}\right) * \frac{1 - 0.65}{0.65} = 401.6kn.m$$

$\gamma = 0.7$

$$kn = \frac{107.78}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.04$$

$$Rn = \frac{401.6}{0.7 * 25 * .4 * .4 * .4 * 1000} = 0.35$$

$\rho g = 0.062 \ldots \ldots \rho min < \rho < \rho max$

$AS = 0.062 * 400 * 400 = 9920mm$

$$no\ of\ bars = \frac{9920}{490} = 19.2$$

$use\ 20\ \theta\ 25$

Fc`=50mpa

Pu=99.2kn

Mu eq=401.6kn.m

$\gamma = 0.6$

$$kn = \frac{99.2}{0.7 * 50 * 0.3 * 0.3 * 1000} = 0.03$$

$$Rn = \frac{401.6}{0.7 * 50 * 0.3 * 0.3 * 0.3 * 1000} = 0.42$$

$\rho = \rho max = 0.08$

$As = 0.08 * 300 * 300 = 7200mm$

$$no\ of\ bars = \frac{7200}{490} = 14.69$$

$use\ 15\ \theta\ 25$

DESIGN COL(7)

Pu=14.38(5.375*6.25)+1.67*5.375+1.67*6.25+19.6

Pu=522kn

$$wu\ x = 2\left[\frac{14.38 * 3.5}{3}\right] + 1.67 = 35.22kn/m$$

$$wu\ x = \left[\frac{14.38 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 = 35.52\frac{kn}{m}$$

$$mu\ x = \frac{35.5 * 6.85}{10} - \frac{35.22 * 3.1}{10} = 135.4kn.m$$

$$wu\ y = \frac{14.38 * 6.25}{3} = 29.95\ kn/m$$

$$mu\ y = \frac{29.95 * 5.85}{10} = 106kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{106}{135.4} = 0.78 < \frac{b}{h}$$

$$mu\ eq = 135.4 + \frac{106\left(\frac{0.4}{0.4}\right)(1 - 065)}{0.65} = 192.47kn.m$$

$\gamma = 0.7$

$$kn = \frac{522}{0.7 * 25 * 0.4 * 0.4 * 1000} = 0.19$$

$$Rn = \frac{192.47}{0.7 * 25 * 0.4 * 0.4 * 0.4 * 1000} = 0.18$$

$\rho g = 0.021 \ldots \ldots \rho min < \rho < \rho max$

As=0.021*400*400=3360mm^2

$$no\ of\ bars = \frac{3360}{490} = 6.8$$

$use\ 7\ \theta\ 25$

Fc`=50mpa

Pu=513.4kn

Mu eq=206.8kn.m

$\gamma = 0.6$

$kn = 0.16$

$Rn = 0.2$

$\rho g = 0.031 \ldots \ldots \rho min < \rho < \rho max$

AS=0.031*300*300=2790mm^2

No of bars=2790/490=5.6

$use\ 6\ \theta\ 25$

DESIGN COL(8)

Fc`=25mpa

Pu=14.38(3.325*3.825)+1.67*3.325+1.67*3.825+19.6+10.5

Pu=225kn

$$wu\ x = \frac{14.38 * 6.25}{3} * \frac{3 - .86}{2} + 1.67 + 10.5 = 46.03\frac{kn}{m}$$

$$wu\ y = \frac{14.38 * 6.25}{3} + 1.67 + 10.5 = 42.13\frac{kn}{m}$$

$$mu\ x = \frac{46.036.85}{16} = 134.9kn.m$$

$$mu\ y = \frac{42.13 * 5.85}{16} = 90.12kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{90.12}{134.9} = 0.67 < \frac{b}{h}$$

$$mu\ eq = 134.9 + \frac{90.12\left(\frac{0.4}{0.4}\right)(1 - 0.65)}{0.65} = 183.43kn.m$$

$$\gamma = 0.7$$

$$kn = 0.08$$

$$Rn = 0.164$$

$$\rho g = 0.025 \dots\dots \rho min < \rho < \rho max$$

AS=0.025*400*400=4000mm^2

$$no\ of\ bars = \frac{4000}{490} = 8.16$$

$use\ 9\ \theta\ 25$

Fc`=50mpa

Pu=216.4kn

Mu eq=188.36kn.m

Kn=0.07

Rn=0.2

$\gamma = 0.6$

$\rho g = 0.036 \ldots\ldots \rho min < \rho < \rho max$

AS=0.036*300*300=3240mm^2

$no\ of\ bars = \frac{3240}{490} = 6.6$ .....use 7 bars

DESIGN COL (9)

Fc`=25mpa

Pu=14.38(5.25*3.8)+1.67*3.8+1.675.25+19.6+10.5

Pu=332kn

$$wu\ x = \left[\frac{14.38 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + \left[\frac{14.38 * 4.25}{3} * \frac{3 - 0.8}{2}\right] + 1.67$$

$$wu\ x = 59.56 \frac{kn}{m}$$

$$wu\ y = \frac{14.38 * 6.25}{3} + 1.67 + 10.5 = 42.13 \frac{kn}{m}$$

$$mu\ x = \frac{59.56 * 6.85}{16} = 279.5 kn.m$$

$$mu\ y = (42.13 * \frac{5.850}{16} = 180.3 kn.m$$

$$\frac{180.3}{279.5} = 0.65 < \frac{b}{h}$$

Mu eq=352.35kn.m

$\gamma = 0.7$

$kn = 0.12$

$Rn = 0.31$

$\rho g = 0.051 \ldots \ldots \rho min < \rho < \rho max$

As=0.051*400*400=8160mm^2

$$no\ of\ bars = \frac{8160}{490} = 14.6$$

$use\ 15\ \theta\ 25$

Fc`=50mpa

Pu=323.4kn

Mu eq=385.3kn.m

Kn=0.1

Rn=0.4

$\gamma = 0.6$

$\rho g = \rho max = 0.08$

AS=0.08*300*300=7200mm^2

$$no\ of\ bars = \frac{7200}{490} = 13.06$$

$use\ 14\ \theta\ 25$

DESIGN COL (10)

Fc`=25mpa

Pu=14.38(5.25*5.4)+1.67*5.25+1.67*5.4+19.6

Pu443.2kn

$$wu\ x = \left[\frac{14.38 * 4.25}{3} * \frac{3 - 0.8}{2}\right] + \left[\frac{14.38 * 6.25}{2} * \frac{3 - 0.86}{2}\right] + 1.67$$
$$= 59.57\frac{kn}{m}$$

$$wu\ x = 2\left[\frac{14.38 * 3.5}{3}\right] + 1.67 = 35.22\frac{kn}{m}$$

$$mu\ x = \frac{59.57 * 6.85}{10} - \frac{35.22 * 3.1}{10} = 245.86 kn.m$$

$$wu\ y = \frac{14.38 * 4.25}{3} + 1.67 = 22\frac{kn}{m}$$

$$wu\ y = \frac{14.38 * 6.25}{3} + 1.67 = 31.63\frac{kn}{m}$$

$$mu\ y = \frac{31.63 * 5.85}{10} - \frac{22 * 3.85}{10} = 75.6 kn.m$$

$$\frac{75.6}{245.86} = 0.3 < \frac{b}{h}$$

$$mu\ eq = 245.86 + \frac{75.6\left(\frac{0.4}{0.4}\right)(1 - 0.65)}{0.65} = 286.56 kn.m$$

$$\gamma = 0.7$$

$$kn = 0.16$$

$$Rn = 0.26$$

$$\rho g = 0.036 \ldots\ldots \rho min < \rho < \rho max$$

AS=0.036*400*400=5760mm^2

$$no\ of\ bars = \frac{5760}{490} = 11.7$$

$$use\ 12\ \theta\ 25$$

Fc`=50mpa

Pu=434.6kn

Mu eq=297.36kn.m

Kn=0.14

Rn=0.3

$\gamma = 0.6$

$\rho g = 0.053 \ldots \ldots \rho min < \rho < \rho max$

AS=0.053*300*300=4770mm^2

$$no\ of\ bars = \frac{4770}{490} = 9.7$$

$use\ 10\ \theta\ 25$

DESIGN COL (11)

Fc`=25mpa

Pu=14.38(5.25*5.75)+1.67*5.25+1.67*5.75+19.6

Pu=472kn

$$wu\ x = \frac{14.38 * 0.75}{3} + \left[\frac{14.38 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 = 39.125\frac{kn}{m}$$

$$wu\ x = \frac{2(14.38 * 3.5)}{3} = 33.55\frac{kn}{m}$$

$$mu\ x = \frac{39.125 * 7.6}{10} - \frac{33.55 * 3.1}{10} = 193.75kn.m$$

$$wu\ y = \left[\frac{14.38 * 3.5}{3} * \frac{3 - 0.86}{2}\right] + \left[\frac{14.38 * 6.25}{3}\right] + 1.67 = 54.16\frac{kn}{m}$$

$$wu\ y = \left[\frac{14.38 * 0.75}{3} * \frac{3 - 0.18}{2}\right] + \left[\frac{14.38 * 3.5}{3} * \frac{3 - 0.8}{2}\right] + 1.67 = 23.67\frac{kn}{m}$$

$$mu\ y = \frac{54.16 * 5.85}{10} - \frac{26.67 * 3.85}{10}$$
$$= 145.8 kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{145.8}{193.75} = 0.75 < \frac{b}{h}$$

$$mu\ eq = 193.75 + \frac{145.8\left(\frac{0.4}{0.4}\right)(1 - 0.65)}{0.65}$$
$$= 266.65 kn.m$$

$kn = 0.16$

$Rn = 0.23$

$\rho g = .03$

AS=0.031*400*400=4960mm^2

$$no\ of\ bars = \frac{4960}{490} = 9.79$$

Fc`=50mpa

Pu=463.42kn

Mu eq=275.33kn

Kn=0.15

Rn=0.29

ρg =0.051

As=0.051*300*300=4590mm^2

$$no\ of\ bars = \frac{4590}{490} = 9.63$$

$use\ 10\ \theta\ 25$

DESIGN COL(12)

Fc`=25mpa

Pu=14.38(4*5.25)+1.67*4+1.67*5.25+19.6

Pu=337kn

$$wu\ y = \left[\frac{14.38 * 2.75}{3} * \frac{3 - 0.64}{2}\right] + 1.67 = 18.68\frac{kn}{m}$$

$$wu\ y = \left[\frac{14.38 * 6.25}{3}\right] + 1.67 = 3163\frac{kn}{m}$$

$$mu\ y = \frac{31.63 * 5.85}{10} - \frac{18.68 * 3.85}{10} = 80.56 kn.m$$

$$wu\ x = \left[\frac{14.38 * 2.75}{3} + \frac{14.38 * 6.25}{3} * \frac{3 - 0.78}{2}\right] + 1.67 = 47.3\frac{kn}{m}$$

$$mu\ x = \frac{47.3 * 7.6}{16} = 170.753 kn.m$$

$$\frac{80.56}{170.753} = 0.47 < \frac{b}{h}$$

$$mu\ eq = 214.13 kn.m$$

$$kn = 0.12$$

$$Rn = 0.2$$

$$\rho g = 0.028$$

$$AS = 0.028 * 400 * 400 = 4480 mm$$

$$no\ of\ bars = \frac{4480}{490} = 9.12$$

$$use\ 10\ \theta\ 25$$

Fc`=50mpa

Pu=328.4kn

Mu eq=221.32kn.m

Kn=0.1

Rn=0.23

$\gamma = 0.6$

$\rho g = 0.029 \ldots \ldots \rho min < \rho < \rho max$

$AS = 0.029 * 300 * 300 = 2160$

$no\ of\ bars = \frac{2160}{490} = 5.3$

$use\ 6\ \theta\ 25$

DESIGN COL(1)

Wu=15kn/m

Partition=3.5*0.25*20*1.4=24.5kn/m

Weight of stem=1.67kn/m

Dimension of column=(450mm*450mm)

Weight of column=(0.45*0.45*3.5*25*1.4)=23.8kn/m

Fc`25mpa

Pu=131.6+(15*2.27*2.85)+(1.67*2.27)+(1.67*2.85)+23.8+24.5

Pu=285.5kn

$$wu\ x = \left[\frac{15 * 4.25}{3} * \frac{3 - 0.78}{2}\right] + 1.67 + 24.5 = 51.46\ kn/m$$

$$wu\ y = \left[\frac{15 * 4.25}{3}\right] + 1.67 + 24.5 = 47.42\frac{kn}{m}$$

$$mu\ x = \frac{51.46 * 4.25}{16} = 160.8 kn.m$$

$$mu\ y = \frac{47.42 * 3.8}{16} = 70.29 kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{70.29}{160.8} = 0.43 < \frac{b}{h} =$$

$$mu\ eq = 160.8 + \frac{70.29\left(\frac{0.45}{0.45}\right)(1 - 0.65)}{0.65} = 195.95 kn.m$$

$$kn = \frac{285.5}{0.7 * 25 * 0.45 * 0.45 * 1000} = 0.08$$

$$Rn = \frac{195.95}{0.7 * 0.45 * 0.45 * 0.45 * 25 * 1000} = 0.12$$

$$\gamma = 0.7$$

$$\rho g = 0.015 \ldots \ldots \rho min < \rho < \rho max$$

AS=0.015*450*450=3038mm^2

No of bars =3038/490=6.45

$$use\ 7\ \theta\ 25$$

Fc`=50mpa

Dimension of column=400*400mm

Pu=281.3kn

Mu eq=195.95kn.m

Kn=0.05

Rn=0.09

$$\gamma = 0.7$$

$$\rho g = \rho min = 0.01$$

As=0.01*400*400=1600mm^2

$$no\ of\ bars = \frac{1600}{490} = 3.2$$

$$use\ 4\ \theta\ 25$$

DESIGN COL(2)

Fc`=25mpa

Pu=168.6+(15*2.85*3.125)+(1.67*2.85)+(1.67*3.125)+23.8+24.5

Pu=360.47 kn

$$wu\ x = \left[\frac{15*4.25}{3} * \frac{3-0.78}{2}\right] + \frac{15*2}{2} + 1.67 + 24.5 = 66.446\frac{kn}{m}$$

$$wu\ y = [\left(15 * \frac{4.250}{3}\right] + 1.67 + 24.5 = 47.42\frac{kn}{m}$$

$$mu\ x = \frac{66.46*5}{16} = 207.68kn.m$$

$$mu\ y = \frac{47.42*3.8}{10} = 70.29kn.m$$

$$\frac{70.29}{207.68} = 0.338 < \frac{b}{h} = 1$$

$$mu\ eq = 207.68 + \frac{70.29\left(\frac{0.45}{0.45}\right)(1-0.65)}{0.65}$$
$$= 242.8kn.m$$

$\gamma = 0.7$

$kn = 0.1$

Rn=0.15

$\rho g = 0.02 \ldots\ldots \rho min < \rho < \rho max$

As=0.02*450*450=4050mm^2

$$no\ of\ bars = \frac{4050}{490} = 8.2$$

$use\ 9\ \theta\ 25$

Fc`=50mpa
Pu=356.27kn

Mu eq=242.8kn.m

Kn=0.06

Rn=0.08

$\rho g = 0.012 \ldots\ldots \rho min < \rho < \rho max$

As=0.012*400*400=1920mm^2

$$no\ of\ bar = \frac{1920}{490} = 3.9$$

$use\ 4\ \theta\ 25$

DESIGN COL(3)

Fc`=25mpa

Pu=257+(15*4.125*3.78)+1.67*4.125+1.67*3.787+23.8+24.5

Pu=552.38kn

$$wu\ x = \left[\frac{15 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 24.5 = 76.48\frac{kn}{m}$$

$$wu\ y = \left[\frac{15 * 6.25}{3}\right] + 1.67 + 24.5 = 57.42\frac{kn}{m}$$

$$mu\ x = \frac{(76.48 * 6.8)}{10} = 353.6kn.m$$

$$mu\ y = \frac{57.42 * 5.8}{10} = 193.16kn.m$$

$$\frac{193.16}{353.6} = 0.55 < \frac{b}{h} = 1$$

$$mu\ eq = 353.6 + \frac{193.16\left(\frac{0.45}{0.45}\right)(1 - 0.65)}{0.65} = 455.97kn.m$$

Kn=0.15

Rn=0.28

$\gamma = 0.7$

$\rho g = 0.042 \ldots\ldots \rho min < \rho < \rho max$

AS=0.042*450*450=8505mm^2

$$no\ of\ bars = \frac{8505}{490} = 17.3$$

Fc`=50mpa

Pu=5480.18kn

Mu eq=457.11kn.m

Kn=0.09

Rn=0.02

$\gamma = 0.7$

$\rho g = 0.031 \ldots \ldots \rho min < \rho < \rho max$

As=0.031*400*400=4960mm^2

$$no\ of\ bars = \frac{4960}{490} = 10.12$$

$use\ 11\ \theta\ 25$

DESIGN COL(4)

Fc`=25mpa

Pu=211.8+(15*3.8*3.5)+1.67*3.8+1.67*3.5+23.8+24.5

Pu=460kn

$$wu\ x = \left[\frac{15 * 6.25}{3} * \frac{3 - .86}{2}\right] + 1.67 + 24.5 = 61.49 \frac{kn}{m}$$

$$wu\ y = \left[\frac{15 * 6.25}{3}\right] + 1.67 + 24.5 = 57.42 \frac{kn}{m}$$

$$mu\ x = \frac{61.49 * 6.8}{16} = 177.7 kn.m$$

$$mu\ y = \frac{57.42 * 5.8}{16} = 120.72 kn.m$$

$$\frac{120.72}{177.7} = 0.68 < \frac{b}{h} = 1$$

$$mu\ eq = 177.7 + \frac{120.72 \left(\frac{0.45}{0.45}\right)(1 - 0.65)}{0.65} = 253.06 kn.m$$

Kn=0.13

Rn=0.16

$\rho g = 0.021 \ldots \ldots \rho min < \rho < \rho min$

AS=0.021*450*450=4252mm^2

$$no\ of\ bars = \frac{4252}{490} = 8.6$$

$use\ 9\ \theta\ 25$

Fc`=50mpa

Pu=455.08kn

Mu eq=245.42kn.m

Kn=0.08

Rn=0.1

$\rho g = 0.012$

AS=0.012*400*400=1920mm^2

$$no\ of\ bars = \frac{1920}{490} = 3.9$$

$use\ 4\ \theta\ 25$

DESIGN COL(5)

Fc`=25mpa

Pu=533.5+(15*5.5*6.25)+1.67*6.25+1.67*5.5+23.8+24.5

Pu=1117kn

$$wu\ x = 2\left[\frac{15 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 24.5 = 96.8\frac{kn}{m}$$

$$wu\ x = 2\left[\frac{15 * 3.5}{3}\right] + 1.67 + 24.5 = 61.8\frac{kn}{m}$$

$$mu\ x = \frac{96.8 * 6.8}{10} - \frac{61.17 * 2.8}{10} = 424.2kn.m$$

$mu\ y = 0$

Kn=0.3

Rn=0.4

$\rho g = 0.045$

As=0.045*450*450=9112mm^2

$$no\ of\ bars = \frac{9112}{490} = 18.6$$

$use\ 19\ \theta\ 25$

Fc`=50mpa

Pu=1112.8kn

Mu eq=429.18kn.m

Kn=0.19

Rn=0.2

$\rho g = 0.025$

AS=0.025*400*400=4000mm^2

$$no\ of\ bars = \frac{4000}{490} = 9.16$$

$use\ 10\ \theta\ 25$

DESIGN COL(6)

Fc`=25mpa

Pu=107.8+(15*6.25*3.8)+1.67*3.8+1.67*6.25+23.8+24.5

Pu=529.11kn

$$wu\ x = \left[\frac{15 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 24.5 = \frac{96.7kn}{m}$$

$$wu\ y = \frac{15 * 6.25}{3} + 1.67 + 24.5 = 57.42\frac{kn}{m}$$

$$mu\ x = \frac{96.7 * 6.8}{16} = 279.5kn.m$$

$$mu\ y = \frac{57.42 * 5.8}{10} = 193.16kn.m$$

$$\frac{193.16}{279.5} = 0.69 < \frac{b}{h} = 1$$

$$mu\ eq = 279.5 + \frac{193.16\left(\frac{0.45}{0.45}\right)(1-0.65)}{0.65} = 376kn.m$$

Kn=0.15

Rn=0.23

$$\rho g = 0.032$$

AS=0.032*450*450=6480mm^2

$$no\ of\ bars = \frac{6480}{490} = 13.2$$

Fc`=50mpa

Pu=524.9kn

Mu eq=387.75kn.m

Kn=0.09

Rn=0.17

$$\rho g = 0.024 \ldots \ldots \rho min < \rho < \rho max$$

AS=0.024*400*400=3840mm^2

$$no\ of\ bars = \frac{3840}{490} = 7.8$$

$$use\ 8\ \theta\ 25$$

DESIGN COL(7)

Fc`=25mpa

Pu=522+(15*5.375*6.25)+1.67*6.25+1.67*35.375+23.8+24.5

Pu=1093.4kn

$$wu\ x = \frac{2(15*3.5)}{3} + 1.67 + 24.5 = 61.17\frac{kn}{m}$$

$$wu\ x = \frac{(15*6.25)}{3} * \frac{3-0.86}{2} + 1.67 + 24.5 = 61.48\frac{kn}{m}$$

$$mu\ x = \frac{61.48*6.8}{10} - \frac{61.17*3.05}{10} = 227.4 kn.m$$

$$wu\ y = \frac{15*6.25}{3} + 1.67 + 24.5 = 57.42\ kn/m$$

$$mu\ y = \frac{57.42*5.8}{10} = 193.16 kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{193.16}{227.4} = 0.85 < \frac{b}{h} = 1$$

$kn = 0.3$

$Rn = 0.2$

$\gamma = 0.7$

$\rho g = 0.02$

AS=0.02*450*450=4050mm^2

$$no\ of\ bars = \frac{4050}{490} = 8.26$$

$use\ 9\ \theta\ 25$

Fc`=50mpa

Pu=1089kn

Mu eq=333.85kn.m

Kn=0.19

Rn=0.15

P g=0.015……ρ min$<$ρ$<$ρ max

$AS=0.015*400*400=2400mm^2$

No of bars=2400/490=4.8

$use\ 5\ \theta\ 25$

DESIGN COL(8)

Fc`=25mpa

Pu=225+(15*3.325*3.325)+1.67*3.325+1.67*3.325+23.8+24.5

Pu=476kn

$$wu\ x=\left[\frac{15*6.25}{3}*\frac{3-0.86}{2}\right]+1.67+24.5=61.5\frac{kn}{m}$$

$$wu\ y=\frac{15*6.25}{3}+1.67+24.5=57.42\frac{kn}{m}$$

$$mu\ x=\frac{61.5*6.8}{16}=177.7kn.m$$

$$mu\ y=\frac{57.42*5.8}{16}=120.72kn.m$$

$$\frac{mu\ y}{mu\ x}=\frac{120.72}{177.7}=0.68<\frac{b}{h}=1$$

$$mu\ eq=177.7+120.72\left(\frac{0.45}{0.45}\right)\left(1-\frac{0.650}{0.65}\right)=238.06kn.m$$

Kn=0.13

Rn=0.15

$\rho g=0.019$

$AS=0.019*450*450=3847.5mm^2$

$$no\ of\ bars=\frac{3847.5}{490}=7.85$$

$use\ 8\ \theta\ 25$

Fc`=50mpa

Pu=471.8kn

Mu eq=245.45kn.m

Kn=0.08

Rn=0.1

$\rho g = 0.012$

AS=0.012*400*400=1920mm^2

$$no\ of\ bars = \frac{1920}{490} = 3.9$$

$use\ 4\ \theta\ 25$

DESIGN COL (9)

Pu=332+(15*5.75*3.8)+1.67*3.8+1.67*5.25+23.8+24.5

Pu=694.6kn

$$wu\ x = \left[\frac{15*6.25}{3}*\frac{3-0.86}{2}\right]+1.67+24.5 = 86.48\frac{kn}{m}$$

$$wu\ y = \left[\frac{15*6.25}{3}\right]*1.67+24.5 = 57.42\frac{kn}{m}$$

$$mu\ y = \frac{57.42*5.8}{16} = 120.72kn.m$$

$$mu\ x = \frac{86.48*6.8}{16} = 249.93kn.m$$

$$\frac{120.72}{249.93} = 0.48 < \frac{b}{h} = 1$$

$$mu\ eq = 249.9.+\frac{120.72\left(\frac{0.45}{0.45}\right)(1-0.65)}{0.65} = 310.29kn.m$$

$kn = 0.2$

$Rn = 0.19$

$\rho g = 0.022 \ldots \ldots \rho min < \rho g < \rho max$

$AS=0.022*450*450=4455mm^2$

$$no\ of\ bars = \frac{4455}{490} = 9.09$$

$use\ 10\ \theta\ 25$

Fc`=50mpa

Pu=690.4kn

Mu eq=318.69kn.m

Kn=0.12

Rn=0.14

$\rho g = 0.018 \ldots \ldots \rho min < \rho g < \rho max$

$AS=0.018*400*400=2880mm^2$

$$no\ of\ bars = \frac{2880}{490} = 5.8$$

$use\ 6\ \theta\ 25$

DESIGN COL(10)

$Pu = 934.5kn$

$$wu\ x = 2\left[\frac{15 * 3.5}{3}\right] + 1.67 + 24.5 = 61.17\frac{kn}{m}$$

$$wu\ x = \left[\frac{15 * 4.25}{3} * \frac{3 - .45}{2}\right] + \left[\frac{15 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 24.5$$

$wu\ x = 86.5kn.m$

$$mu\ x = [\frac{86.5 * 6.8}{10} - \frac{61.17 * 3.05}{10} = 343kn.m$$

$$wu\ y = \left[\frac{15 * 6.25}{3}\right] + 1.67 + 24.5 = 57.42\frac{kn}{m}$$

$$wu\ y = \left[\frac{15 * 4.25}{3}\right] + 1.67 + 24.5 = 47.42\frac{kn}{m}$$

$$mu\ y = \frac{57.42 * 5.8}{10} - \frac{47.42 * 3.8}{10} = 124.68kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{124.68}{343} = 0.36 < \frac{b}{h} = 1$$

$$mu\ eq = 343 + 124.68\left(\frac{0.45}{0.45}\right)(1 - \frac{0.650}{0.65} = 405.34kn.m$$

$$kn = 0.26$$

$$Rn = 0.25$$

$$\rho g = 0.032 \ldots \ldots \rho min < \rho g < \rho max$$

AS=0.032*450*450=6480mm^2

$$no\ of\ bars = \frac{6480}{490} = 13.2$$

$$use\ 14\ \theta\ 25$$

$$fc` = 50mpa$$

$$Pu = 930.3kn$$

$$mu\ eq = 416.16kn.m$$

$$kn = 0.16$$

$$Rn = 0.18$$

$$\rho g = 0.022$$

AS=0.022*400*400=3520mm^2

$$no\ of\ bars = \frac{3520}{490} = 7.15$$

$$use\ 8\ \theta\ 25$$

DESIGN COL(11)

Fc`=25mpa

Pu=472+(15*5.75*5.25)+1.67*5.75+1.67*5.25+23.8+24.5

Pu=998kn

$$wu\ x = \left[\frac{15*0.75}{3} + \frac{15*6.25}{3} * \frac{3-0.86}{2}\right] + 1.67 + 24.5 = 65.22\frac{kn}{m}$$

$$wu\ x = 2\left[\frac{15*3.5}{3}\right] + 1.67 + 24.5 = 61.17\frac{kn}{m}$$

$$mu\ x = \frac{65.22*7.55}{10} - \frac{61.17*2.8}{10} = 314.8kn.m$$

$$wu\ y = \left[\frac{15*3.5}{3} * \frac{3-0.56}{2} + \frac{15*6.25}{3}\right] + 1.67 + 24.5 = 80.92\frac{kn}{m}$$

$$wu\ y = \left[\frac{15*0.75}{3} * \frac{3-0.18}{2} + \frac{15**3.5}{3} * \frac{3-0.8}{2}\right] + 1.67 + 24.5$$
$$= 52.38\frac{kn}{m}$$

$$mu\ y = \frac{80.92*5.8}{10} - \frac{52.38*3.8}{10} = 196.56kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{196.56}{314.8} = 0.62 < \frac{b}{h} = 1 \ldots\ldots mu\ eq = 413kn.m$$

$kn = 0.28$

$Rn = 0.26$

$\rho g = 0.028 \ldots\ldots \rho min < \rho g < \rho max$

As=0.028*450*450=5670mm^2

$$no\ of\ bars = \frac{5670}{490} = 11.57$$

$use\ 12\ \theta\ 25$

Fc`=50mpa

Pu=982.8kn

Mu eq=422.15kn.m

Kn=0.17

Rn=0.18

$\rho g = .022$

AS=0.022*400*400=3520mm^2

$no\ of\ bars = \frac{3520}{490} = 7.1$

$use\ 8\ \theta\ 25$

DESIGN COL(12)

Fc`=25mpa

Pu=337+(15*5.25*4)+1.67*5.25+1.67*4+24.5+23.8

Pu=715.7kn

$$wu\ x = \left[\frac{15 * 2.75}{3} + \frac{15 * 6.25}{3} * \frac{3 - 0.86}{2}\right] + 1.67 + 24.5 = 75.22\frac{kn}{m}$$

$$mu\ x = \frac{75.22 * 7.55}{16} = 267.98 kn.m$$

$$wu\ y = \left[\frac{15 * 2.75}{3} * \frac{3 - 0.64}{2}\right] + 1.67 + 24.5 = 43.9\frac{kn}{m}$$

$$wu\ y = \frac{15 * 6.25}{3} + 1.67 + 24.5 = 57.42\frac{kn}{m}$$

$$mu\ y = \frac{57.42 * 5.8}{10} - \frac{43.9 * 3.8}{10} = 129.77 kn.m$$

$$\frac{mu\ y}{mu\ x} = \frac{129.77}{267.98} = 0.48 < \frac{b}{h} = 1$$

$$mueq = 267.98 + \frac{129.77\left(\frac{0.45}{0.45}\right)(1 - 0.65)}{0.65} = 332.86 kn.m$$

Kn=0.2

Rn=0.2

$\rho g = 0.024$

AS=0.024*450*450=4860mm^2

$no\ of\ bars = \frac{4860}{490} = 9.9$

$use\ 10\ \theta\ 25$

Fc`=50mpa

Pu=711.5kn

Mu eq=342kn.m

Kn=0.13

Rn=.015

$\rho g = 0.018$

AS=0.018*400*400=2880mm^2

$no\ of\ bars = \frac{2880}{490} = 5.8$

$use\ 6\ \theta\ 25$

DESIGN SLAB(7)

La/Lb=6/3.25=1.8

Design as two way slab

M=0.55

6m
3.25m

m^-	M^+ DL	M^+ LL	W Load
Ca=0.089 Cb=0.007	Ca=0.035 Cb=0.003	Ca=0.062 Cb=0.006	Wa=0.92 Wb=0.08

Short direction

Ma^-=0.084*15*$(3.25)^2$

Ma^-=13.3kn.m

Ma^+=[0.035*8.2+0.062*6.8]*$(3.25)^2$

Ma^+=7.5kn.m

Long direction

Mb^-=0.007*15*$(6)^2$=3.78kn.m

Mb^+=[0.003*8.2+0.006*6.8]*$(6)^2$=2.35kn.m

Short direction

Fc`=25mpa

da=160-20-12/2=134mm

max moment=13.3kn.m

$\rho = 0.002$

$\rho min = 0.0033$

$\rho max = 0.02$

$\rho = \rho min = 0.0033$

As=0.0033*1000*134

As=442.2mm^2

Long direction

db=122mm

max moment=3.78kn.m

fc`=25mpa

$\rho = 0.00068$

$\rho = \rho min = 0.0033$

$As = 0.0033 * 1000 * 122$

$As = 403mm$

$S = \min\left[1000 * \frac{113}{403}, 2 * 160, 500\right]$

$S = 280mm$

$no\ of\ bars = \frac{As}{Ab} = \frac{403}{113} = 4\ bars@each\ (1m)$

Fc`=50mpa

$\rho = 0.00674$

$\rho = \rho min$

$As = 0.0033 * 1000 * 122 = 403mm$

$S = \min\left[1000 * \frac{113}{403}, 320, 500\right]$

$S = 280mm$

$no\ of\ bars = \frac{403}{113} = 4\ bars\ @\ each\ (1m)$

Check shear

W=wu*La*Lb

W=15*6*3.25=293

Wa=W*wa=293*0.92=270

Wb=W*wb=293*0.08=23

Va=23

Vb=4

$$Va > vb$$

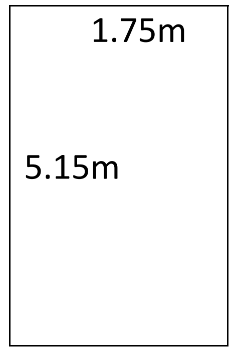
$$\frac{23 - 15 * 0.92 * 0.134}{0.85} = 25kn$$

$$Vc = 0.17 * \sqrt{fc`} * b * d$$

$$fc` = 25mpa \;\ldots\ldots \qquad Vc = 108.8 > 25kn \;\ldots\ldots.\; ok$$

$$fc` = 50mpa \;\ldots\ldots. Vc = 154 > 25kn \;\ldots\ldots. ok$$

DESIGN SLAB(6)



$$\frac{La}{Lb} = \frac{5.15}{1.75} = 2.9 > 2$$

$design\ as\ one\ way\ slab$

$$d = 160 - 20 - \frac{12}{2} = 134mm$$

$$mu = \frac{wu * \ln 2}{10} = \frac{15 * 1.75}{10} = 4.6kn.m$$

$$mu = \frac{15 * 1.75}{11} = 4kn.m$$

$$mu = \frac{15 * 1.75}{16} = 3kn.m$$

$$\max\ moment = 4.6kn.m$$

$$fc` = 25mpa$$

$$\rho = 0.00068$$

$$\rho = \rho min$$

$$As = 0.0033 * 1000 * 134 = 442.2mm$$

As min=0.0018*1000*160=241.2mm^2

$$S = \min\left[1000 * \frac{113}{442.2}, 480\ ,500\right]$$

$$S = 250mm$$

Spacing for shrinkage and temperature

$$S = \min\left[1000 * \frac{113}{241.2}, 800\ ,500\right]$$

S=460mm

$no\ of\ bars = \frac{442.2}{113} = 4\ @\ each\ (1m)$

$fc` = 50mpa$

$\rho = \rho min = 0.0033$

$AS = \rho * b * d$

$AS = 0.0033 * 1000 * 134$

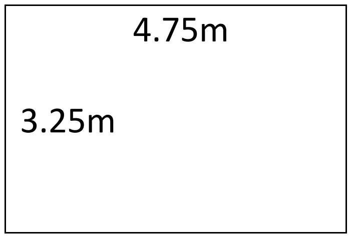
$AS = 442.2mm$

$S = 250mm$

$S\ \ shrinkage\ and\ temp$=460mm

No of bars=4@ each(1m)

DESIGN SLAB( )



Lb/La=4.75/3.25=1.46

Design as two way slab

M=0.7

M^-	M^+DL	M^+DL	W Load
ca=0.068 cb=0.029	Ca=0.04 Cb=0.011	Ca=0.054 Cb=0.014	Wa=0.68 Wb=0.32

short direction

$Ma^-=0.068*15*(3.25)^2=10.77kn.m$

$Ma^+=[0.04*8.2+0.054*6.8]*(3.25)^2=7.3kn.m$

Long direction

$Mb^-=0.029*15*(4.75)^2=9.8kn.m$

$Mb^+=[0.011*8.2+0.014*6.8]*(4.75)^2=4.2kn.m$

Short direction

da=134mm

max moment=10.77kn.m

Fc`=25mpa

$$\rho = 0.0016$$

$$\rho = \rho min = 0.0033$$

$As=0.0033*1000*134=442.2mm^2$

$$S = \min[1000 * \frac{113}{442.2}, 320 ,500]$$

S=250mm

No of bars=4 bars @ (1m)

Long direction

db=122mm

max moment=9.8kn.m

$\rho = 0.0018$

$\rho = \rho min = 0.0033$

AS=0.0033*1000*122=403mm^2

$$S = \min\left[1000 * \frac{113}{403}, 320\ ,500\right]$$

S=280mm

No of bars=4 bars @ (1m)

Fc`=50mpa

$\rho = 0.00175$

$\rho = \rho min = 0.0033$

AS=0.0033*1000*122=403mm^2

S=min[1000*113/403 ,320 ,500]

S=280mm

No of bars=4 bars @ (1m)

CHECK SHEAR

W=wu*La*Lb=15*4.75*3.25

W=232

Wa=232*0.68=158

Wb=232*0.32=72.24

va=17

vb=11

va>vb

$$\frac{va - W * wa * da}{\theta} = \frac{17 - 15 * 0.68 * 0.134}{0.85} = 18kn$$

Fc`=25mpa

$Vc = 108.8 > 18\,kn \;\ldots\ldots ok$

Fc`=50mpa

$Vc = 154 > 18kn \;\ldots\ldots ok$

VOLUME OF CONCRETE SLABS

Slab (1)=6.25*7.25*0.16=7.25m^3

Slab (2)=6.25*8*0.16=8m^3

Slab (3)=6.25*7.25*0.16=7.25m^3

Slab (4)=5.4*4.25*0.16=3.672m^3

Slab (5)=4.25*3.5*0.16=2.38m^3

Slab (6)=2*5.4*0.16=1.728m^3

Slab (7)=3.5*6.25*0.16=3.5m^3

Total volume of concrete for one story=33.78m^3

Total volume for two story=67.56m^3

VOLUME OF BEAMS CONCRETE

fc`=25mpa

Volume of beams=0.35*0.25*243.6=21.315m^3

Volume of beams for two story=42.63m^3

fc`=50mpa

Volume of beams=0.3*0.2*243.6=14.616m^3

Volume of beams for two story=29.232m^3

VOLUME OF COLUMNS CONCRETE

Ground plan

Fc`=25mpa

Volume of columns=0.45*0.45*3.5*32=22.68m3

Fc`=50mpa

Volume of columns=0.4*0.4*3.5*32=17.92m^3

First story

Fc`=25mpa

Volume of columns=0.4*0.4*3.5*23=17.92m^3

Fc`=50mpa

Volume of columns=0.3*0.3*3.5*32=10.08m^3

Total volume at fc`=25mpa

Total volume=22.68+17.92=40.6m^3

Total volume at fc`=50mpa

Total volume=17.92+10.08=28m^3

Type of concrete	Fc`=25mpa	Fc`=50mpa
slabs	67.56m^3	67.56m^3
beams	42.63m^3	29.232m^3
columns	40.6m^3	28m^3
Total volume of concrete	150.79m^3	124.792m^3

Total cost=150.79*450000=70000000dinar ……fc`=25mpa

cost of stabilizer=80000dinar/m^3

amount of stabilizer=18 liter/m^3

Total cost=124.792*45000*18*80000=80*10^{10} ……fc`=50mpa

CALCULATION OF RIENFORCEMENT AMOUNT

Ground plan

Fc`=25mpa

Col 1=7*5.5*3.855=148.4kg

Col 2=9*5.5*3.855=190.822kg

Col 3=16*5.5*3.855=339.24kg

C0l 4=9*5.5*3.855=190.822kg

Col 5=18*5.5*3.855=381.645kg

Col 6=15*5.5*3.855=318.375kg

Col 7=9*5.5*3.855=190.822kg

Col 8=8*5.5*3.855=169.62kg

Col 9=10*5.5*3.855=212kg

Col 10=14*5.5*3.855=296.835kg

Col 11=14*5.5*3.855=296.835kg

Col 12=10*5.5*3.855=212kg

Total of reinforcement amount=2974.95*2=5949.9kg

Total of reinforcement amount=6ton

Fc`=50mpa

Col 1=4*5.5*3.855=84.81kg

Col 2=4*5.5*3.855=84.81kg

Col 3=11*5.5*3.855=233.2kg

Col 4=4*5.5*3.855=84.81kg

Col 5=10*5.5*3.855=212kg

Col 6=8*3.855*5.5=169.62kg

Col 7=5*3.855*5.5=106kg

Col 8=4*5.5*3.855=84.81kg

Col 9=6*3.855*5.5=127.2kg

Col 10=8*5.5*3.855=169.62kg

Col 11=8*3*5.5*3.855=169.62kg

Col 12=6*5.5*3.855=127.2kg

Total of reinforcement amount=1484.84*2=2969.68kg

Total of reinforcement amount=3ton

First plan

Fc`=25mpa

Col 1=4*5.5*3.855=84.81kg

Col 2=6*5.5*3.855=127.2kg

Col 3=14*5.5*3.85=296.8kg

Col 4=11*5.5*3.855=233.22kg

Col 5=12*5.5*3.855=254.43kg

Col 6=20*5.5*3.855=508.86kg

Col 7=7*5.5*3.855=148.4kg

Col 8=9*5.5*3.855=190.8kg

Col 9=15*5.5*3.855=318kg

Col 10=12*5.5*3.855=254.43kg

Col 11=10*5.5*3.855=212kg

Col 12=10*5.5*3.855=212kg

Total of reinforcement amount=2840.9*2=5721.1kg

Total of reinforcement amount=5.75ton

Fc`=50mpa

Col 1=3*5.5*3.855=63.6kg

Col 2=6*5.5*3.855=127.2kg

Col 3=12*5.5*3.855=254.4kg

Col 4=9*5.5*3.855=190.82kg

Col 5=10*5.5*3.855=212kg

Col 6=15*5.5*3.855=318kg

Col 7=6*5.5*3.855=127.2kg

Col 8=7*5.5*3.855=148.4kg

Col 9=14*5.5*3.855=296.8kg

Col 10=10*5.5*3.855=212kg

Col 11=10*5.5*3.855=212kg

Col 12=6*5.5*3.855=127.2kg

Total of reinforcement amount=2235.62*2=4471.24kg

Total of reinforcement amount=4.5ton

.TOTAL OF RIENFORCEMENT AMOUNT FOR TWO STORY

Total amount=6+5.75=11.75=12ton …..fc`=25mpa

Total cost=12*850000=10200000 dinar …..fc`=25mpa

Total amount=3+4.5=7.5=8ton …...fc`=50mpa

Total cost=8*850000=6800000 dinar ……fc`=50mpa

Total difference of reinforcement amount=12-8=4ton

Difference of total cost=4*850000=3500000 dinar

Cost of building=10200000+70000000=80200000 dinar …….fc`=25mpa

Cost of building=6800000+80*10^{10}=800006800000 dinar ……fc`=50mpa